AD/A-006 395

THE EFFECT OF QUIET ON HEARING

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January 1975

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER AMRL-TR-74-99	2. GOVT ACCESSION NO	3. RECIPIENT'S CATALOG NUMBER AD/A006 395
4. TITLE (and Subtitle) THE EFFECT OF QUIET ON HEARING		5. TYPE OF REPORT & PERIOD COVERED Inhouse Research
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Charles W. Nixon, PhD Mark R. Stephenson, 2nd Lt, USAF		8. CONTRACT OR GRANT NUMBER(s) N/A
9. PERFORMING ORGANIZATION NAME AND ADDRESS AEROSPACE MEDICAL RESEARCH LABORATORY AEROSPACE MEDICAL DIVISION, AIR FORCE SYSTEMS COMMAND, WRIGHT-PATTERSON AFB, OH 45433		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 62202F/7231/03/16
11. CONTROLLING OFFICE NAME AND ADDRESS		12. REPORT DATE January 1975
		13. NUMBER OF PAGES ~~24~~ 22
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Temporary Threshold Shift
Audition
Hearing Sensitivity
Noise Induced Hearing Loss
Noise and Auditory Function
Quiet and Hearing

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The hearing of subjects participating in psychoacoustic experiments may be elevated (temporary hearing loss) due to environmental noises encountered prior to their arrival at the test site. Hearing threshold levels of trained subjects were measured immediately upon arrival at the Laboratory and again following individual 1/2, 1, and 2 hour periods in the quiet of an anechoic chamber. Comparisons of prequiet and postquiet thresholds revealed a slight trend of 1 or 2 decibles toward improved hearing after quiet. However, the changes in

hearing thresholds were not statistically significant and were judged to be too small to be of practical significance. Although these findings are negative, procedures should be implemented with all studies involving hearing sensitivity to insure that environmental noise induced temporary hearing loss is not present in subjects prior to test sessions.

SUMMARY

Hearing threshold levels of subjects were measured, using manual and automatic audiometry, immediately upon arrival at the laboratory and again following individual ½, 1, and 2 hour periods in quiet. Results indicate that;

(1) Generally, evidence of prequiet threshold elevation due to environment noise was not found. Mean differences between pre- and postquiet thresholds were not statistically significant.

(2) The optimum time required in quiet to avoid TTS in pretest data depends on the prior noise exposure of the subjects. Criteria for assessing pretest thresholds to avoid TTS should be tailored to the specific study in which the subjects will participate.

(3) The current procedures employed in our laboratory for eliminating effects of environmental noise on pretest hearing threshold levels are adequate.

(4) Data collected with the two audiometric methods are comparable, with the manual method showing slightly less variability in mean response data than the automatic technique.

Although a slight increase in mean hearing sensitivity was observed following periods of quiet, the magnitude of the changes was judged to be too small to be of practical significance in routine laboratory investigations involving noise induced temporary threshold shift.

PREFACE

This study was accomplished by the Biodynamics and Bionics Division, Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base, Ohio. The research was conducted by Charles W. Nixon and Lt. Mark R. Stephenson of the Biological Acoustics Branch, Biodynamics and Bionics Division. The research was accomplished under Project 7231, "Biomechanics of Air Force Operations," Task 723103, "Effects of Operational Noise On Air Force Personnel," and Work Unit 016, "Auditory Responses to Acoustic Energy Experienced in Air Force Activities."

INTRODUCTION

Noise induced temporary threshold shift (NITTS or TTS) is a behavioral phenomenon widely used in the study of the response of the ear to excess acoustic energy[2]. The typical paradigm employed in these investigations involves measurements of hearing threshold levels prior to and immediately following programmed noise exposures. Criterion measures are described as differences between pre- and postexposure values that are compared to one another to show elevated thresholds or losses of hearing sensitivity due to the acoustic energy. Generally, great care is taken in conducting the hearing threshold level measurements and in describing the testing procedure. However, little if any information is presented on the noise exposure and/or the hearing threshold levels of the subjects prior to the prenoise exposure measures.

Volunteers in experimental investigations of noise effects on hearing are not necessarily in quiet environments prior to initiation of test sessions. In many situations it is common for volunteers to travel from nearby locations to the test laboratory by motor vehicle. Noise exposure produced by automobiles, buses, and motorcycles is sufficient to temporarily elevate hearing threshold levels, particularly for ears sensitive to noise. Other environmental noise exposures unknown to the experimenter may also create NITTS in the test subjects. The overall result of such occurrences is an underestimation of the magnitude of the effect of the experimental noise exposure. Also, postexposure recovery time is defined in terms of the elevated baseline instead of the normal hearing threshold levels, which erroneously assigns a time that is less than is actually needed for recovery. Procedures should be implemented to insure that the preexposure hearing levels of experimental subjects are not already elevated due to noise exposure occurring prior to the test session. Exposure guidelines and standards that incorporate data collected on subjects with elevated preexposure thresholds would be in error.

Investigations of the effects of acoustic energy on the human auditory system make up a substantial portion of the ongoing inhouse research program of the Biodynamics and Bionics Division of the Aerospace Medical Research Laboratory. Typically, volunteers travel from local universities by personal conveyance to participate in the various studies. The incidence of the use of motorcycles by these individuals has stimulated concern that the current practice of providing short rest periods in quiet prior to test might no longer be adequate. Although the amount of time spent in quiet by a subject varies with the nature of the investigation, it could be as short as ten minutes. Specifically, the preexposure hearing thresholds of the subjects might be elevated due to exposure to transportation and other environmental noise, thus affecting results based on the comparison of pre- and posttest data. This investigation was conducted in response to this potential problem.

PURPOSE

The purpose of this study was to determine the amount of time in quiet required for the hearing threshold levels of experimental volunteers to stabilize, that is, to exhibit no elevated threshold levels. Data would be used to determine if current laboratory practices employed to avoid elevated thresholds are satisfactory and to identify the optimum amount of time required in quiet to avoid NITTS preceding investigations of hearing threshold sensitivity. Hearing thres-

hold leve of the subjects were measured immediately upon arrival at the laboratory and compared to repeat measurements taken after various periods of time in the quiet of an anechoic chamber. To be able to apply the results directly to the inhouse program activities the same instrumentation and procedures typically used in such programs were utilized.

PROCEDURE

The study was designed to examine hearing threshold sensitivity for audiometric test frequencies ranging from 125 to 8000 Hz prior to and following individual periods of relative quiet of ½, 1 and 2 hours duration. We assumed that any threshold elevations due to environmental noise exposures typically experienced by the subjects would return to within normal limits in less than 2 hours in quiet. Both manual and automatic audiometric procedures were evaluated since each is used for threshold assessment in the laboratory. The test frequencies to which the normal ear is generally most sensitive were tested earliest in the sequence of 4000, 2000, 1000, 6000, 8000, 500, 250, and 125 Hz.

TEST FACILITY AND INSTRUMENTAATION

Hearing threshold sensitivity assessment and the various periods of relative quiet were experienced by the subjects in a large anechoic chamber 30 by 30 by 30 feet in size. A block diagram of the facility and instrumentation used for calibration and hearing testing is presented in Figure 1. The manual audiometric system utilized a General Radio Audiometric Oscillator as the signal generator and Grason Stadler attenuators and electronic switches to process the signal for presentation by a Telephonics TDH 39 headphone for monotic listening. A Rudmose ARJ 6A Automatic Clinical Audiometer (special purpose) was employed in the automatic phase of the testing program. The same headphone was used with both systems and was periodically calibrated on a National Bureau of Standards 9A artificial ear. The noise floor of the test chamber was measured using the Bruel and Kjaer microphone system and General Radio Real Time Analysis System displayed in Figure 2.

SUBJECTS

Male college students from a laboratory pool of trained subjects volunteered to participate in the study. Hearing threshold levels of the subjects were within the normal range as described in ANSI S3.6–1969[1]. The noise exposure history of the subject was determined each day and no unusual exposures were reported on the days of the study sessions. Twelve subjects participated in the manual audiometry phase of the study and six with the automatic audiometry. Five of the six men participated in both measurement phases. Although each subject had participated in prior studies of this type and were trained in hearing threshold determinations, practice with this test arrangement and both audiometric methods was maintained until the experimenter determined that individual performance was reliable.

DATA ACQUISITION

Trained subjects arrived individually at the laboratory at prescheduled times and immediately entered the test chamber. Hearing threshold levels were measured for the test signals as soon

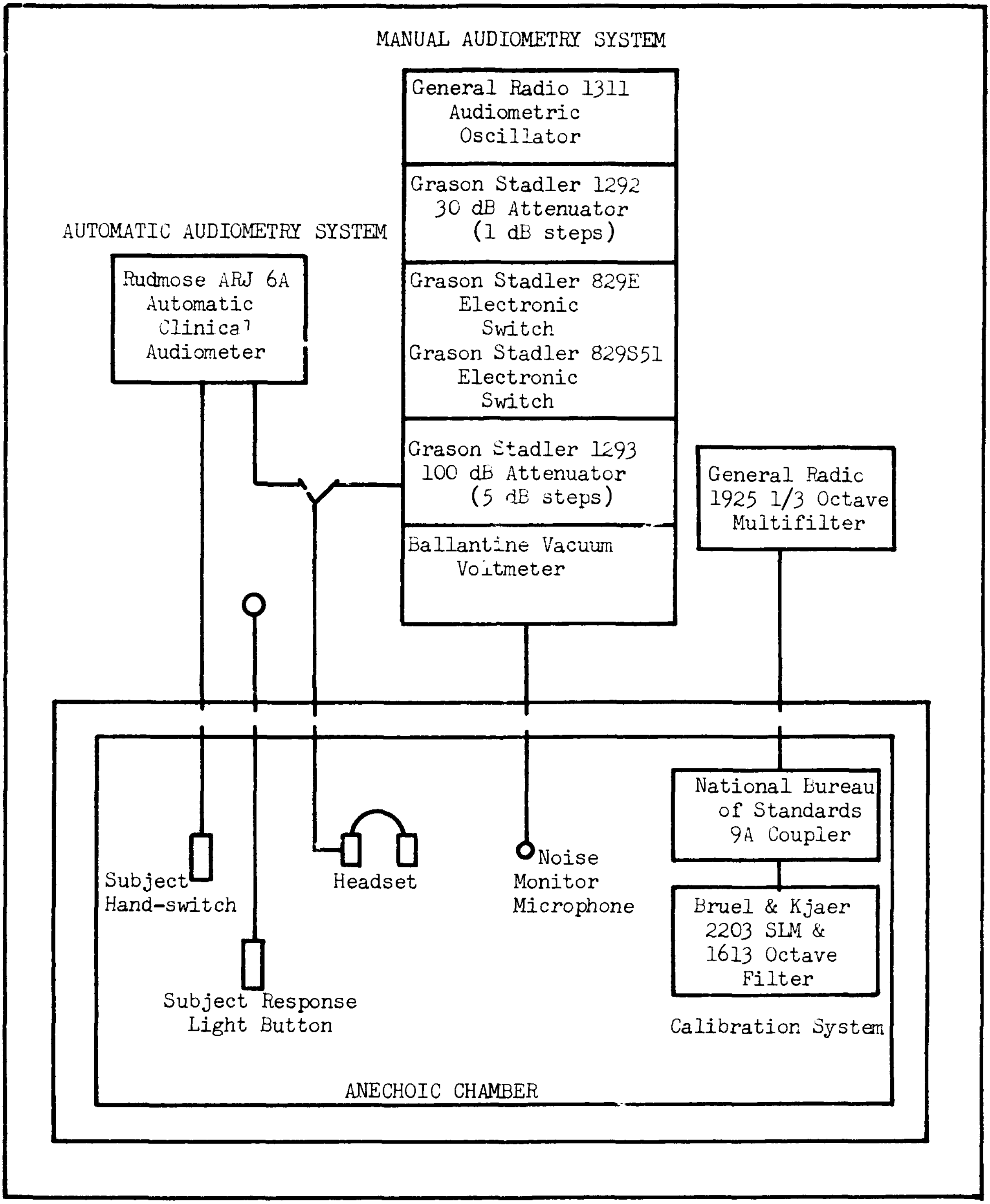

FIGURE 1 FACILITY AND INSTRUMENTATION

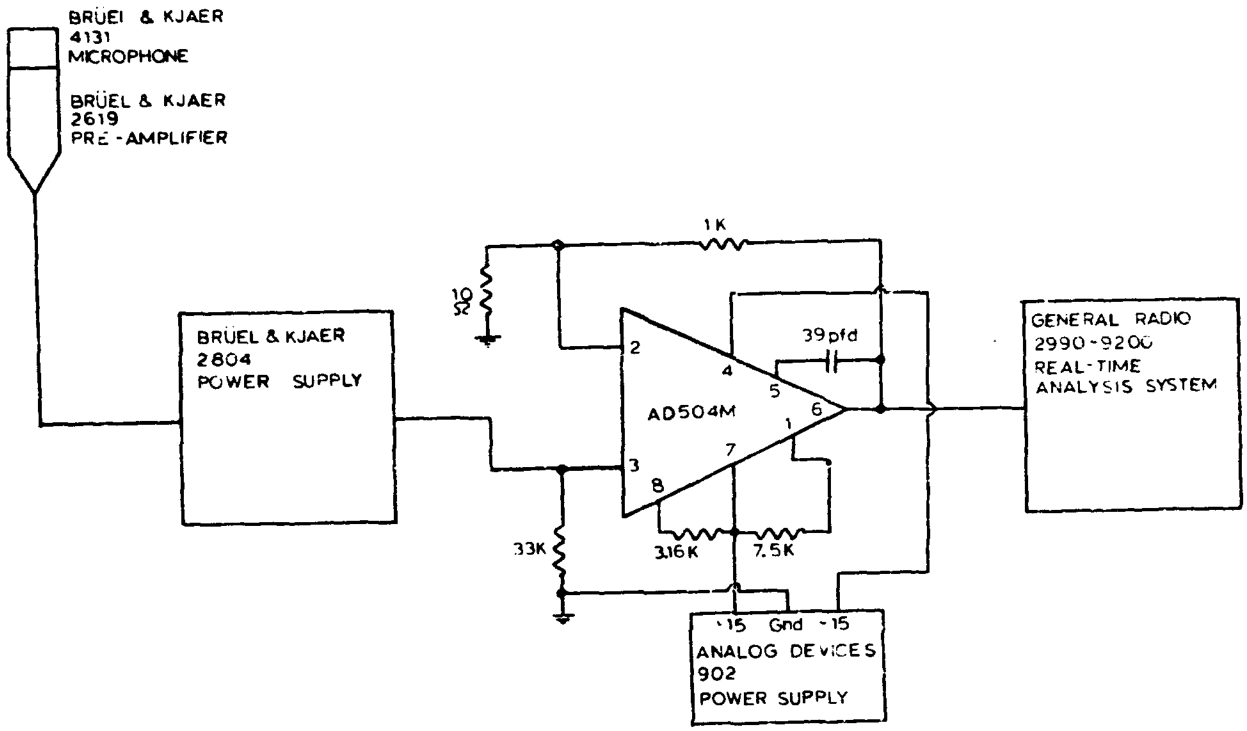

FIGURE 2 ANECHOIC CHAMBER INSTRUMENTATION SYSTEM

as the subject was fitted with the earphone, the door was closed and the experimenter was able to initiate the test. Following these measurements the subject remained inside the chamber for either ½, 1 or 2 hours in accordance with the experimental design. During the quiet period the subject was required to remain in the subject location and to refrain from generating any noise, even talking. Subjects made use of reading material during this time period, but were not allowed to sleep. Following the period of quiet, and a signal from the experimenter, the headset was replaced by the subject and postquiet thresholds measured.

The psychophysical method of limits[4] was employed in the manual audiometry phase and subjects pressed a response light button to indicate when the tone was heard. The test signals were randomly interrupted by the experimenter. Signals were varied in 1 decibel steps and several threshold crossings were observed in the determination of each threshold value for a signal. The method of adjustment[4] was used in the automatic audiometry phase whereby the subject hand switch controlled a motor-driven attenuator that continuously varied the intensity of the test signal, higher or lower depending upon the position of the switch. The level of the signal was varied at a rate of 2.5 dB per second and each test tone was presented for a period of 30 seconds. The test tone was automatically interrupted at a rate of 2.5 times per second with rise and decay times free of audible acoustics transients. When a consistent pattern of threshold crossings for a test signal was not observed by the experimenter an override switch was activated and the threshold for that frequency continued to be plotted until it stabilized. In both manual and automatic audiometry, questionable threshold values were always rechecked.

The same procedure was employed with both audiometric phases of the data collection. All test sessions were completed with the manual audiometry before the automatic audiometry phase was initiated. The hearing threshold levels of the subjects were defined in terms of absolute sound pressure level (re 20 μPa) as well as in terms of the attenuator settings of the audiometers. Criterion measures were defined as the differences between the prequiet and the postquiet hearing levels at each test frequency (postquiet minus prequiet values).

RESULTS

The individual prequiet and postquiet absolute hearing threshold levels for subjects participating in the manual audiometry phase are contained in Tables 1, 2 and 3 for the quiet periods of ½, 1, and 2 hours, respectively. Data from Table 1 for the ½ hour condition are also displayed in graphic form in Figure 3 to show the very good agreement between the pre- and postquiet threshold data observed for all conditions. The spread of data points at each test frequency reflects the variation in sensitivity among subjects. The ambient noise level of the test room and the Sivian and White[5] monaural minimum audible pressure (MAP) threshold values are also presented in each of these figures. Good agreement with the Sivian and White values is observed, except at 125 Hz. The hearing threshold levels are well above the background noise in the test chamber.

Inspection of the pre- and postquiet data points in these Tables and in Figure 3 does not reveal any clearcut differences between the two groups of data, although a very slight trend for improved postquiet hearing might be inferred. Consequently, the data were tabulated and analyzed in terms of mean values and mean difference scores. The individual difference scores

TABLE 1 INDIVIDUAL HEARING THRESHOLD LEVELS (RE 20 μPA) VIA MANUAL AUDIOMETRY FOR 0.5 HOUR QUIET CONDITION

SUBJECT	TEST FREQUENCY (Hz) 125		250		500		1000		2000		4000		6000		8000	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	48	53	23	25	13	13	13	13	8	8	18	17	20	16	21	19
2	52	49	37	32	24	23	17	14	26	22	15	12	17	17	14	15
3	54	53	39	34	19	19	15	16	10	9	7	7	15	18	15	16
4	41	41	26	26	16	10	3	0	8	6	8	4	6	2	7	9
5	52	48	31	34	18	11	8	6	6	4	5	3	16	21	8	14
6	51	51	20	21	8	4	6	3	2	−2	7	10	18	17	27	23
7	44	—	24	21	8	7	12	11	15	10	5	3	17	17	23	17
8	55	50	24	25	11	13	3	3	0	−4	9	9	18	13	18	17
9	49	45	34	37	29	25	22	19	12	6	16	15	23	19	21	14
10	44	45	24	24	7	5	4	4	8	6	7	3	13	14	26	32
11	54	54	30	30	11	10	8	7	11	8	11	8	16	16	25	24
12	45	44	25	21	6	2	0	−1	7	6	2	5	17	17	13	10

TABLE 2 INDIVIDUAL HEARING THRESHOLD LEVELS (RE 20 μPA) VIA MANUAL AUDIOMETRY FOR 1 HOUR QUIET CONDITION

SUBJECT	TEST FREQUENCY (Hz) 125		250		500		1000		2000		4000		6000		8000	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	48	48	20	19	7	6	8	8	4	4	15	13	18	16	10	9
2	52	49	35	34	22	23	16	11	25	20	13	13	14	16	19	19
3	56	53	33	35	15	17	15	14	9	8	9	10	9	14	15	15
4	44	44	25	26	7	9	1	−2	4	2	6	7	3	2	6	1
5	45	45	24	24	12	10	7	5	−2	−1	6	6	25	19	4	1
6	56	56	27	27	10	10	7	5	4	3	19	15	15	20	21	18
7	44	44	25	22	9	6	10	12	14	7	5	4	18	21	25	24
8	46	47	23	23	9	9	3	2	0	−3	11	8	15	17	13	18
9	51	51	35	34	27	27	19	19	12	7	17	12	23	20	15	17
10	45	45	26	23	7	6	3	2	10	13	6	4	17	20	30	33
11	56	56	39	39	14	13	3	3	9	9	6	4	16	15	25	22
12	47	44	23	20	9	7	1	−3	6	6	4	5	9	9	11	12

TABLE 3 INDIVIDUAL HEARING THRESHOLD LEVELS (RE 20 μPA) VIA MANUAL AUDIOMETRY FOR 2 HOUR QUIET CONDITION

SUBJECT	TEST FREQUENCY (Hz) 125		250		500		1000		2000		4000		6000		8000	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	48	49	23	23	10	10	10	9	5	6	9	10	20	15	18	11
2	48	49	36	36	22	22	14	15	22	20	14	12	9	15	16	16
3	47	49	24	27	13	13	13	11	+7	6	5	1	14	13	11	10
4	50	45	29	24	11	11	3	3	6	6	10	10	7	6	5	6
5	47	50	28	26	14	15	7	5	0	2	7	7	19	14	11	8
6	55	51	26	22	9	5	5	4	1	1	16	16	18	17	21	17
7	49	49	25	26	11	12	10	10	14	13	3	3	21	18	25	24
8	48	47	24	24	7	7	5	4	−2	+2	10	7	9	11	11	10
9	49	47	34	32	19	15	19	17	12	8	11	15	29	23	21	18
10	49	49	25	24	6	5	2	2	6	7	5	6	27	25	18	22
11	54	51	32	30	14	13	4	4	8	8	3	5	25	19	27	27
12	45	43	18	18	7	4	0	−3	6	3	5	0	7	9	11	10

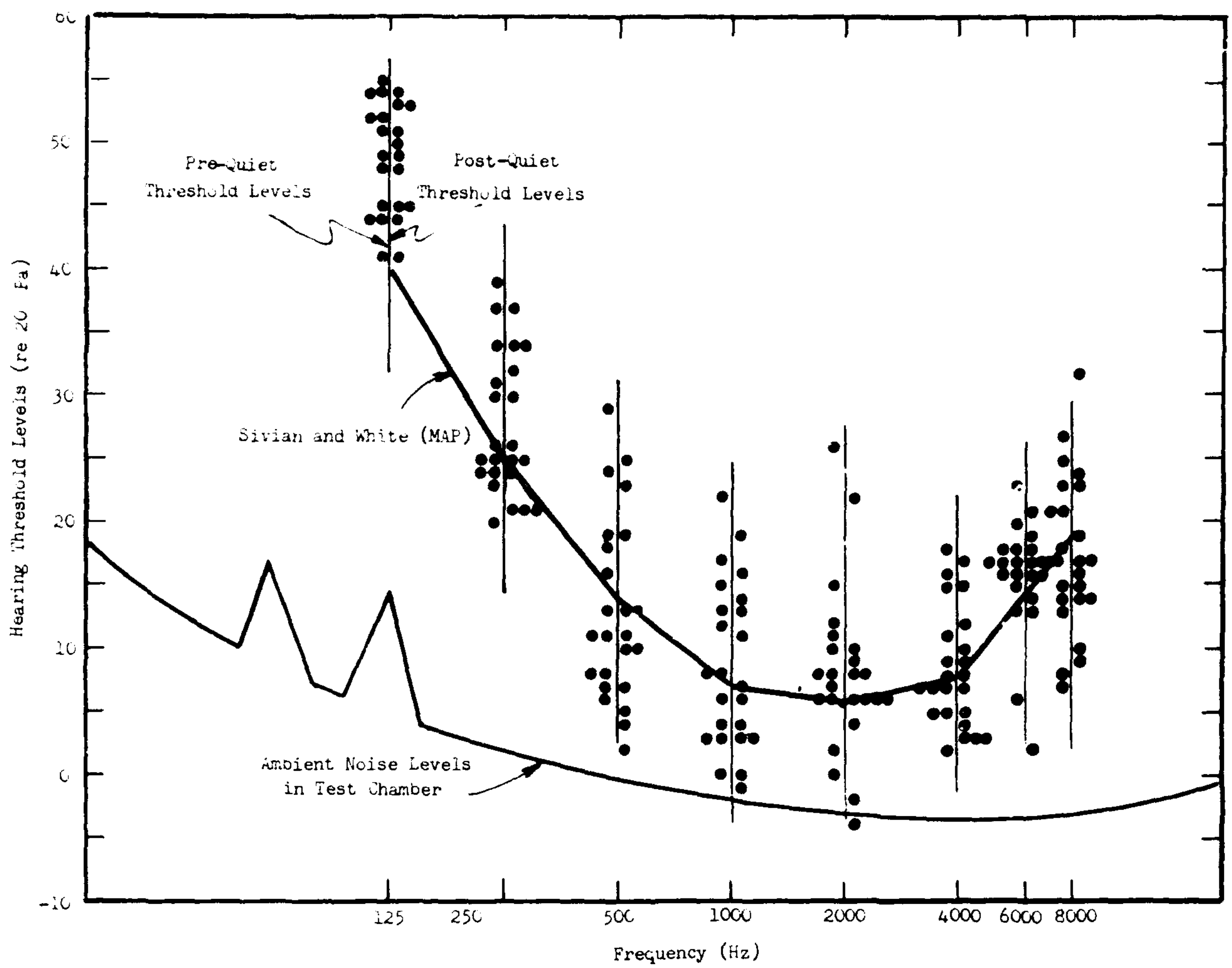

FIGURE 3 ONE HALF HOUR CONDITION PRE- AND POSTQUIET DATA POINTS

for all subjects under both conditions of the study are contained in tabular form in the Appendix. The means, standard deviations, and t-ratios[3] for related measures are summarized for the manual audiometry in Table 4 and the automatic audiometry in Table 5. The positive difference values indicate an increase and the negative values a decrease in hearing sensitivity.

The mean difference scores in Table 4 between the prequiet and postquiet hearing threshold levels are small with a maximum of about 2.8 dB for the ½ hour period and 1.67 dB for the 1 and 2 hour periods. The mean difference score collapsed over subjects, quiet periods and test frequencies is 1.05 dB. The standard deviations seem somewhat large relative to the mean values reflecting difference values ranging from zero to a maximum of 7 decibels.

TABLE 4 MEANS, STANDARD DEVIATIONS AND t RATIOS SUMMARIZED FOR MANUAL AUDIOMETRY

0.5 HOUR QUIET CONDITION

Test Frequency	*125*	*250*	*500*	*1000*	*2000*	*4000*	*6000*	*8000*
Means of Differences	1.0	0.58	2.17	1.33	2.83	1.17	0.75	0.67
Standard Deviation	2.73	2.94	2.62	1.44	1.80	2.23	3.05	4.14
t	1.27	0.71	2.86	3.22*	5.11*	1.83	0.85	0.5

1 HOUR QUIET CONDITION

Test Frequency	*125*	*250*	*500*	*1000*	*2000*	*4000*	*6000*	*8000*
Means of Differences	0.67	0.83	0.42	1.42	1.67	1.33	0.58	0.42
Standard Deviation	1.44	1.59	1.56	1.93	2.87	2.02	3.34	2.87
t	1.60	1.80	0.93	2.54	2.01	2.29	0.52	0.51

2 HOUR QUIET CONDITION

Test Frequency	*125*	*250*	*500*	*1000*	*2000*	*4000*	*6000*	*8000*
Means of Differences	0.92	1.0	0.92	0.92	0.25	0.58	1.67	1.60
Standard Deviation	2.54	2.17	1.78	1.16	2.18	2.54	3.63	2.95
t	1.25	1.59	1.80	2.73	0.40	0.79	1.59	1.68

*Critical value of 3.11 significant at the .01 percent level of confidence

The critical value of the differences between the means at each test frequency, as evaluated by t-tests for related measures, is 3.11 at the 1% level of confidence. Statistically significant differences between the means, representing improved hearing sensitivity, are observed only at the 1000 and 2000 Hz test frequencies for the ½ hour condition. Although the magnitudes of the mean differences are relatively small, the pattern of the significant effects at these two "speech range" test frequencies might be interpreted as recovery of temporary elevations in hearing sensitivity present at the prequiet measurement session. However, similar patterns of significant improvements in hearing were not observed for these or any other test signals for the 1 and 2

TABLE 5 MEANS, STANDARD DEVIATIONS AND t RATIOS SUMMARIZED FOR AUTOMATIC AUDIOMETRY

0.5 HOUR QUIET CONDITION

Test Frequency	*125*	*250*	*500*	*1000*	*2000*	*4000*	*6000*	*8000*
Means of Differences	3	3.83	1.5	2.17	0.5	2.67	0.17	1.83
Standard Deviation	2.37	1.17	1.76	3.66	3.51	3.08	5.85	2.48
t	3.09	7.98*	2.08	1.46	0.35	2.12	.07	1.81

1 HOUR QUIET CONDITION

Test Frequency	*125*	*250*	*500*	*1000*	*2000*	*4000*	*6000*	*8000*
Means of Differences	0.33	2.5	0.67	0.83	0.83	0.17	1.67	3.50
Standard Deviation	1.03	2.95	2.25	2.86	1.33	3.54	3.88	3.27
t	0.79	2.08	0.73	0.71	1.54	0.12	1.06	2.63

2 HOUR QUIET CONDITION

Test Frequency	*125*	*250*	*500*	*1000*	*2000*	*4000*	*6000*	*8000*
Means of Differences	2.0	1.67	0.17	0.17	2.5	0.83	1.67	1.67
Standard Deviation	1.41	2.25	3.49	2.93	2.59	5.42	3.61	5.35
t	3.45	1.82	0.12	0.14	2.36	0.38	1.14	0.77

*Critical value of 4.03 significant at the .01 percent level of confidence

hour quiet periods. Although this improvement in hearing is demonstrated for two test signals for the shortest quiet condition, it does not substantiate that the environmental noise generally experienced by the subject produced TTS that was measurable at the prequiet sessions. Noise induced TTS of this type would be the same or show improvement following the longer duration periods in quiet and not less recovery, however, this was not observed.

The mean difference scores for the automatic audiometry data, which are summarized in Table 5, are comparable to those for the manual audiometry. The overall mean difference for all conditions is about 1.5 dB with a maximum value of 3.83 dB. The standard deviations are relatively large due to the intersubject differences in response. Mean difference scores did not vary as a function of the duration of the quiet periods. Scattergrams showing prequiet and postquiet hearing levels for the three duration conditions are contained in Figures 4, 5, and 6. The distributions of the data points show high positive relations between the pre- and postquiet data with small changes indicated by the alignment of the data along the no-change line. As with the manual audiometric data a slight trend toward better hearing is suggested from the higher number of data points on the prequiet side of the no-change line in each figure. A scattergram of only the three test frequencies of 500, 1000 Hz and 2000 Hz more clearly shows this trend toward improvements in hearing following the short quiet condition (Figure 7). However, the critical value of the differences between the means of these data is 4.03 at the 1% level of confidence (Table 5). This value was exceeded only at 250 Hz for the ½ hour condition and is

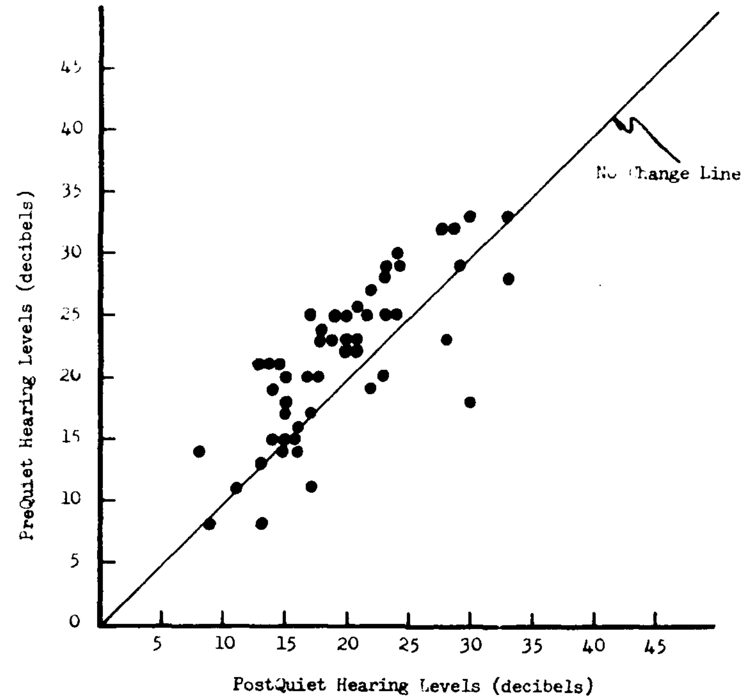

FIGURE 4 AUTOMATIC AUDIOMETRY DATA POINTS FOR 0.5 HOUR QUIET CONDITION

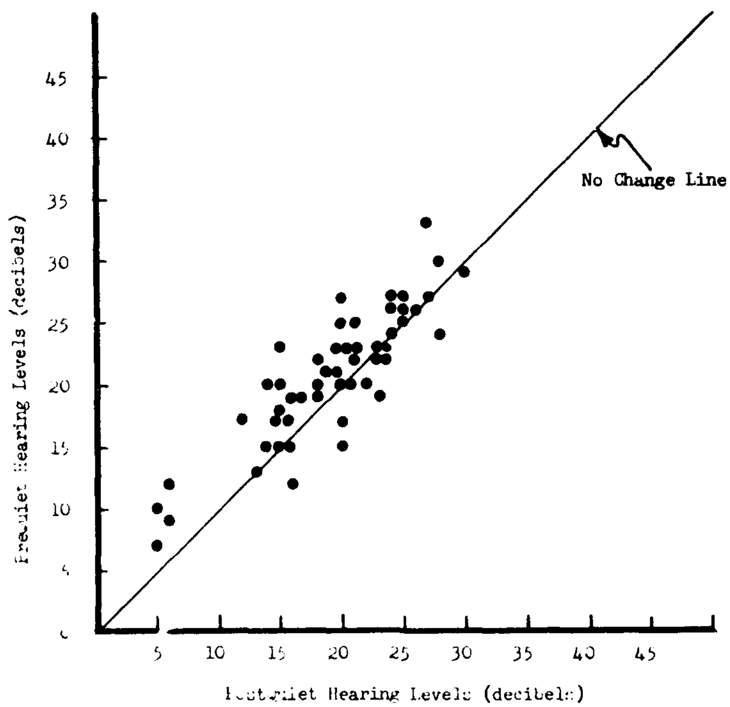

FIGURE 5 AUTOMATIC AUDIOMETRY DATA POINTS FOR 1 HOUR QUIET CONDITION

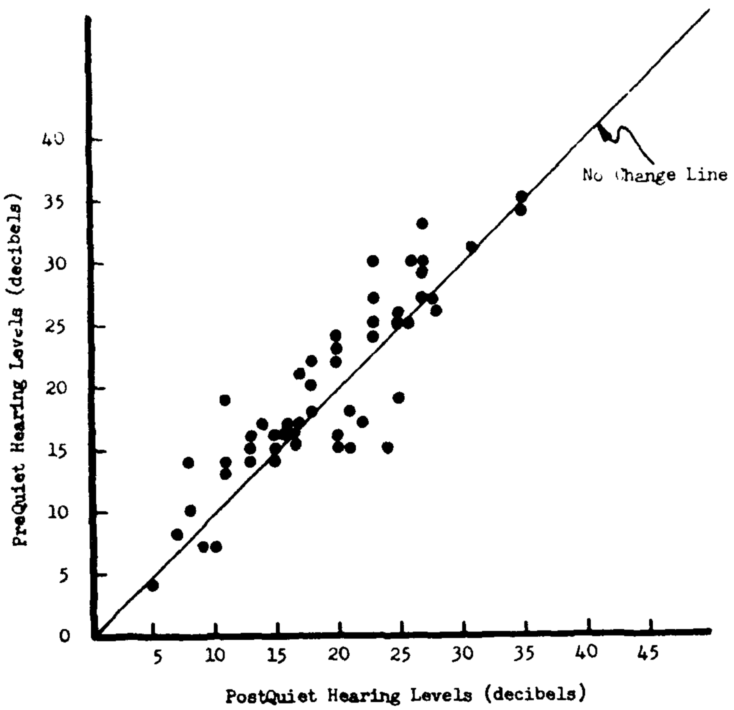

FIGURE 6 AUTOMATIC AUDIOMETRY DATA POINTS FOR 2 HOUR QUIET CONDITION

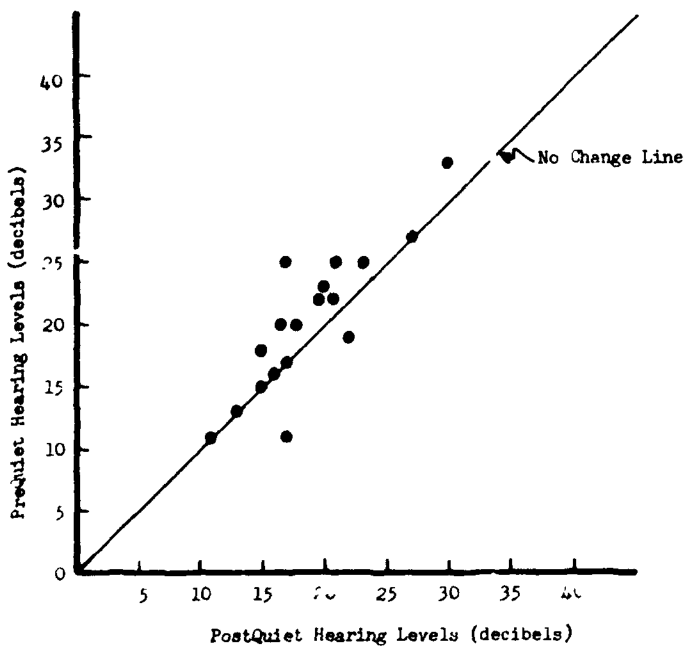

FIGURE 7 AUTOMATIC AUDIOMETRY DATA POINTS FOR TEST FREQUENCIES OF 500 Hz, 1000 Hz AND 2000 Hz FOR 0.5 HOUR QUIET

judged not to be related to consistent elevated prequiet thresholds. Hearing threshold levels for the pre- and the postquiet conditions were very similar and although no patterns of statistically significant differences were observed a trend toward improved hearing sensitivity is clearly indicated.

The mean difference values for both manual and automatic audiometry are graphically depicted in Figure 8 for the three quiet periods. The mean hearing functions independently measured by the two methods show good consistency. The greater variability of the automatic audiometry data is likely related to the small number of subjects (N 6) in that group. The slight improvements in mean hearing sensitivity displayed in Figure 8 appear to be independent of frequency. TTS induced by broad band environmental noises of interest in this study would be expected to affect the hearing region of 4000 Hz first and with the greatest amount of TTS while having no influence on frequencies of 500 Hz and below. Difference scores reflecting recovery of TTS produced in this way would be frequency dependent with the greatest differences appearing around 4000 Hz and no differences below 1000 Hz. This was not observed. The slight changes of mean improved hearing appear for all test frequencies suggesting that the reason for the changes is not noise induced TTS present at the prequiet audiometric testing sessions.

A different approach to the problem under study might be to compare the absolute prequiet hearing threshold levels of the subjects to standard normal hearing reference levels. Agreement between the threshold values and the normative reference values might ordinarily be interpreted as an indication of nonelevated hearing threshold levels. However, some of the studies in the laboratory take place in very quiet environments with young male subjects whose hearing, in many instances, is much better than normative values. Also, the actual measurements following quiet periods were considered necessary to provide a valid basis for deciding an optimum rest period if elevated thresholds were found.

The hearing thresholds described in Tables 1, 2, and 3 and Figure 3 in terms of absolute sound pressure level indicate that the audiometry was satisfactory and that hearing levels were not masked by the background noise in the test chamber. On the basis of the data and its analyses, it is concluded that the procedures presently employed in the laboratory to minimize effects of environmental noise exposure on pretest hearing levels are adequate. A comparison of the individual prequiet and postquiet absolute thresholds suggests trends toward improved hearing but reveals no universal changes. The mean difference scores and the t-tests revealed only sporadic statistically significant differences that could not generally be related to noise induced TTS in prequiet hearing thresholds. The magnitudes of the measured differences are small.

The amount of time required in quiet to assure that pretest hearing thresholds are not elevated by environmental noise depends upon the nature of the noise exposure and of the experiment. Assessment of the hearing of subjects following the same routine typically experienced in traveling to and participating in our laboratory studies showed no significant differences between pre- and postquiet hearing. However, a slight trend reflecting small magnitude changes was evident. Consideration of the data collected in this study suggests that the current practice of requiring ten minutes or more in quiet prior to pretest hearing measurements is adequate to eliminate significant effects on hearing threshold. Although a minimum of about 10 minutes is cited, the actual amount of rest required prior to a test is determined by the nature of the study and the noise exposure of that individual subject. The slight changes observed in these data are judged to be insignificant for practical considerations.

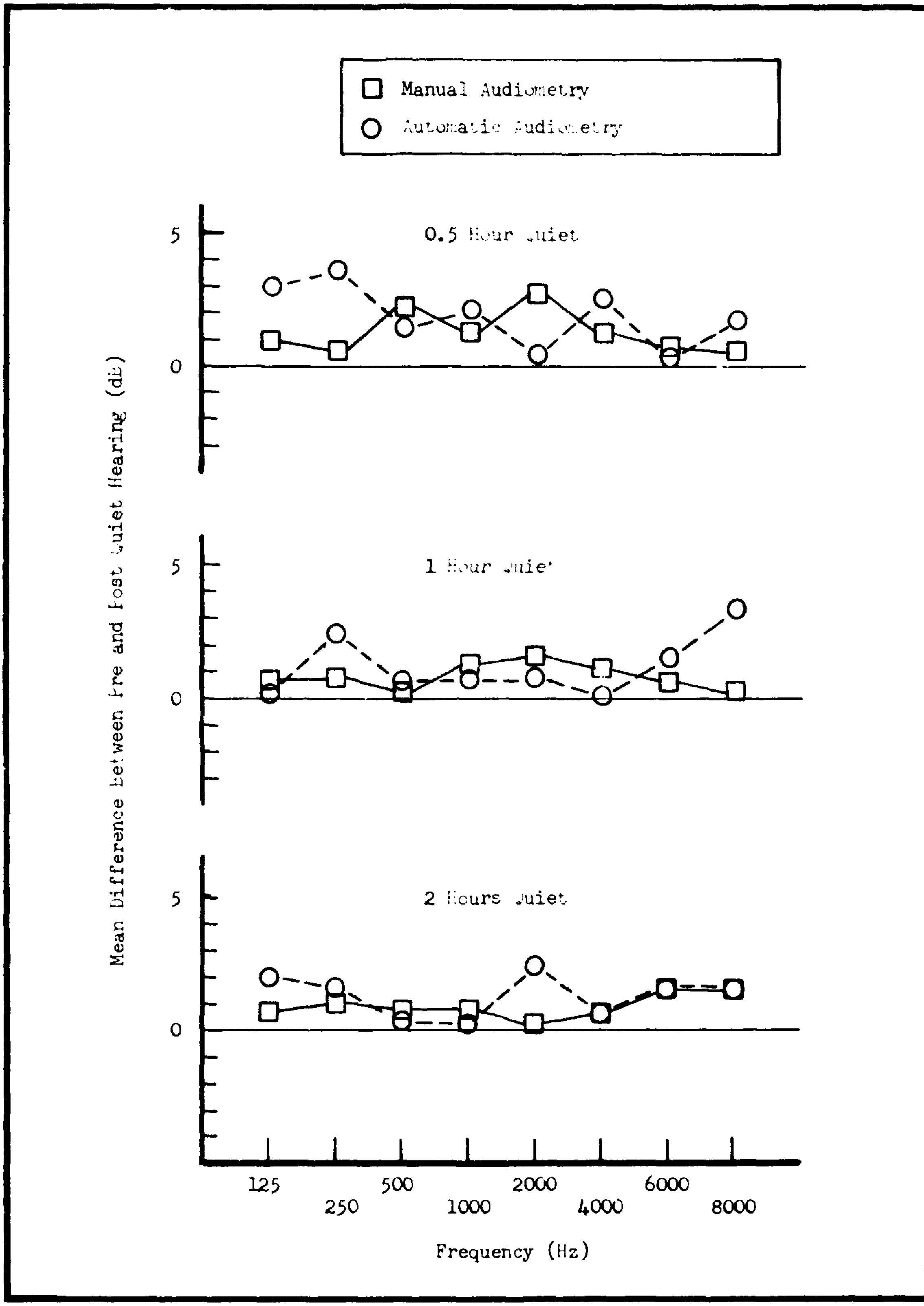

FIGURE 8 MEAN TEMPORARY THRESHOLD SHIFT FOR BOTH MANUAL AND AUTOMATIC AUDIOMETRY

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APPENDIX

HEARING THRESHOLD DATA

MANUAL

0.5 HOUR QUIET

SUBJECT	*125*	*250*	*500*	*1K*	*2K*	*4K*	*6K*	*8K*
1	−5	−2	0	0	0	1	4	2
2	3	5	1	3	4	3	0	−1
3	1	5	0	−1	1	0	−3	−1
4	0	0	6	3	2	4	4	−2
5	4	−3	7	2	2	2	−5	−6
6	0	−1	4	3	4	−3	1	4
7	0	3	1	1	5	2	0	6
8	5	−1	−2	0	4	0	5	1
9	4	−3	4	3	6	1	4	7
10	−1	0	2	0	2	4	−1	−6
11	0	0	1	1	3	3	0	1
12	1	4	8	1	1	−3	0	3

1.0 HOUR QUIET

SUBJECT	*125*	*250*	*500*	*1K*	*2K*	*4K*	*6K*	*8K*
1	0	1	1	0	0	2	2	1
2	3	−1	1	5	5	0	−2	0
3	3	−2	−2	1	1	−1	−5	0
4	0	−1	−2	3	2	−1	1	5
5	0	0	2	2	−1	0	6	3
6	0	1	0	2	1	4	−5	3
7	0	3	3	−2	7	1	−3	1
8	−1	0	0	1	3	3	−2	−5
9	0	1	0	0	5	5	3	−2
10	0	3	1	1	−3	2	−3	−3
11	0	0	1	0	0	2	1	3
12	3	3	2	4	0	−1	0	−1

2.0 HOUR QUIET

SUBJECT	*125*	*250*	*500*	*1K*	*2K*	*4K*	*6K*	*8K*
1	−1	0	0	1	−1	−1	5	7
2	−1	0	0	−1	2	2	−6	0
3	−2	−3	0	2	1	4	1	1
4	5	5	0	0	0	0	1	−1
5	−3	2	−1	2	−2	0	5	3
6	4	4	4	1	0	0	1	4
7	0	−1	−1	0	1	0	3	1
8	1	0	0	1	−4	3	−2	1
9	2	2	4	2	+4	−4	6	3
10	0	1	1	0	−1	−1	2	−4
11	4	2	1	0	0	−2	6	0
12	2	0	3	3	3	5	−2	1

0.5 HOUR QUIET

SUBJECT	125	250	500	1K	2K	3K	4K	6K	8K
1	+4	+4	+4	+3	0	−3	+2	−7	−5
2	+5	+5	0	0	0	−1	+1	0	−5
3	+4	+5	0	−3	−6	−2	+6	+4	0
4	0	+3	+3	+8	+3	+5	+7	0	−1
5	+5	+2	+2	+2	+3	+5	0	+9	0
6	0	+4	0	+3	+3	+7	0	−5	0

1.0 HOUR QUIET

SUBJECT	125	250	500	1K	2K	3K	4K	6K	8K
1	+2	+8	+2	+2	+2	+2	0	0	+6
2	0	+3	+3	0	0	+3	+3	−4	+6
3	0	+2	−3	−4	0	+5	−4	+1	+1
4	0	+2	+2	+4	+3	+2	+2	+1	−2
5	+1	0	+1	0	0	+6	+3	+5	+5
6	−1	0	−1	+3	0	+4	−5	+7	+5

2.0 HOUR QUIET

SUBJECT	125	250	500	1K	2K	3K	4K	6K	8K
1	+2	0	−6	0	+7	+4	+3	0	+2
2	0	+2	+1	−5	+2	−3	−5	0	−1
3	+1	+1	−2	+1	+3	0	+8	0	−3
4	+2	+1	0	−2	0	0	+4	−9	−4
5	+3	+6	+2	+2	+3	+4	−6	0	+9
6	+4	0	+4	+3	0	0	+1	−1	+7

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